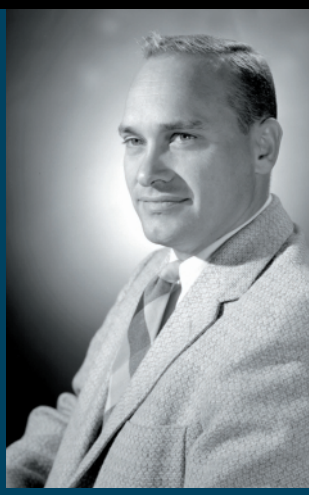
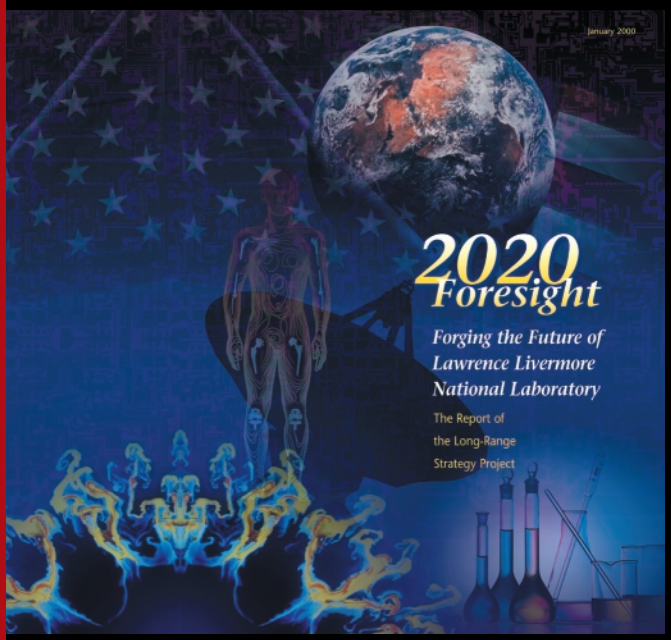
Shaping the Future

Livermore's multidisciplinary approach to problem solving will be needed to address large-scale technical problems that the nation will face in the 21st century. Continuing success in the Laboratory's endeavors will be challenging. We must deliver on major programmatic commitments, ensure that we meet high standards in all operations, and provide a work environment that continues to attract a diverse, highly talented workforce. Our mission-directed research, exceptional science and technology, continuous improvement of operations, workforce and strategic planning, and significant partnerships position the Laboratory for the future.



Positioning the Laboratory for the Future



The Long-Range Strategy Project provided an opportunity for a diverse group of people, who will be making important decisions about the direction of Livermore's programs in the coming decades, to get to know each other and the many issues that the Laboratory faces. Their summary report, *2020 Foresight*, synthesizes and highlights the principal results of their studies.

A Quality Workforce

Livermore's principal asset is its quality workforce. Our achievements are the product of a highly talented, productive, motivated, flexible staff that is committed to the Laboratory's goals. We strive for a workforce that reflects the diversity of California and the nation. And we seek to provide a work environment in which all employees can contribute to the fullest and feel valued for their role. The Laboratory is pursuing initiatives to enhance the work environment.

Our association with the University of California (UC) enhances the Laboratory's intellectual vitality and our ability to recruit and retain a quality workforce. In January 2001, DOE and UC modified and extended to 2005 UC's contract to manage the Laboratory.

Program Direction and Planning

The future direction of the Laboratory is guided by evolving national needs. Livermore's priorities are spelled out in the strategy document, *Creating the Laboratory's Future*, and the Laboratory's *Institutional Plan FY 2001–2005*. In early 2000, the Long-Range Strategy Project, conducted by about 20 early- to mid-career scientists and engineers at Livermore, completed its final report, *2020 Foresight*. The project considered the potential advances in science and technology and prospects for Livermore over the next 10 to 20 years.

In addition, significant organizational changes have been made in response to newly arising programmatic and operational demands on the Laboratory. The selection process is being completed in 2001 for many new top-level managers.

Roger Batzel
1922–2000

The Laboratory's future builds on a foundation of technical excellence and important mission responsibilities. Roger Batzel served as Director for nearly one-third of Livermore's history (1971 to 1988), a time of technical diversification and remarkable growth for the Laboratory. We will sorely miss him.

In an example of our ties to the University of California, Merced Community College President Ben Duran, UC Merced Chancellor Carol Tomlinson-Keasey, and Laboratory Director Bruce Tarter (left to right) gather to sign a Memorandum of Understanding to create academic partnerships among the three institutions. Below, reporters cover the announcement of a formal collaboration between the Laboratory and the UC Davis Cancer Center to pursue research on cancer prevention and control and to develop new treatment techniques.

High Standards in Operations

Our efforts to continually improve Laboratory operations focused in 2000 on safety and security. Both are of prime importance at the DOE nuclear weapons laboratories.

We completed implementation of DOE's Integrated Safety Management System to improve safety performance and management at Livermore. Our policy is that safety of both workers and the public has the highest priority.

The Laboratory also continues to improve security by providing even greater protection of critical assets, implementing state-of-the-art computer security, and expanding our counterintelligence program.

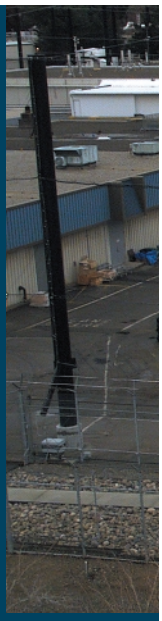
Major Partnerships for Mission Success

Increasingly, Livermore's technical achievements are the result of major partnerships with industry, academia, and other laboratories. Partnerships and collaborations help us accomplish our programmatic goals more efficiently and cost effectively. They also provide a mechanism for commercializing and returning for broad public benefit the technological advances made at the Laboratory.

Award-Winning Science and Technology

Outstanding scientific and technical achievements define the Laboratory and chart its future. Breakthrough accomplishments, critical to Livermore's success, are the product of a quality staff—both individual and team efforts. Frequently, such achievements lead to outside recognition, such as the many awards garnered in 2000.

Safety has the highest priority in all Laboratory operations. In 2000, Livermore implemented DOE's Integrated Safety Management System.



Safety and security are the most important considerations in day-to-day operations. Protection of sensitive information, nuclear materials, and other valuable assets at the Laboratory is a critically important responsibility. So is safety. The Laboratory is committed to providing every employee and the community with a safe and healthy environment in which to work and live. We have taken steps to improve safety and ensure its top priority. Our environmental protection efforts continue to focus on pollution prevention, waste reduction, and cleanup of the Livermore site.

In addition, we broadly contribute to the high-tech, global-outlook atmosphere of the region. Technical expertise, science education efforts, and the many volunteer activities by Laboratory employees are important aspects of being a good neighbor.

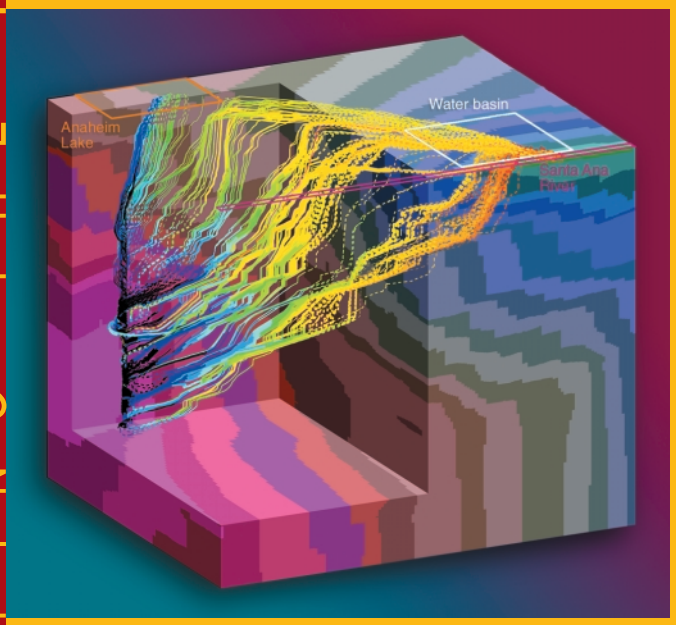
Secure, Safe Operations and a Good Neighbor

Implementing Integrated Safety Management

In 2000, DOE's operational concept, Integrated Safety Management (ISM), was implemented at Livermore. ISM strengthens Livermore's commitment to and performance of safe practices in the workplace.

ISM at Livermore is based on a set of work standards that were developed in partnership with DOE's Oakland Operations Office and the University of California.

A DOE Verification Team determined that the Laboratory effectively implemented ISM. Through the hard work of the ISM implementation team and Laboratory staff, we were well prepared for final verification in September, which entailed the inspection of safety procedures at 25 facilities across the Laboratory and the review of over 700 supporting documents.



The Laboratory aided the Orange County, California, Water District by calculating "backward travel" of water between a production well (at left) and three recharge basins at ground level (upper right). Yellow and orange portions of the color-coded water travel time indicate that the recharged water would stay underground long enough for the water district's needs.

Upgrades to Security

Livermore, Los Alamos, and Sandia national laboratories are expeditiously taking measures to tighten security. Protection of sensitive information and special nuclear materials is vitally important, and we are using increasingly sophisticated measures to provide it. For example, we implemented a tri-laboratory cybersecurity plan developed with DOE. To ensure improvement in identified areas, the plan included numerous specific milestones, such as the installation of an institution-wide firewall to protect all computer systems, which was completed in March 2000.

Our computer-security upgrades build upon our efforts over the past three years to develop an overall information architecture that integrates the Laboratory's needs for both functionality and security in computing. The strategy is to not only comply with DOE orders, but also to proactively determine the computer-security needs of our institution and build the necessary computer-security practices and technologies into our infrastructure.

Environmentally Responsible Operations

The *1999 Site Annual Environmental Report*, released in November 2000, concludes that

In addition to cybersecurity improvements, the Laboratory made important physical and technical upgrades to the security of the Superblock, which contains the plutonium facility, to provide even greater protection against attempted intrusions.

Portable treatment units contribute to the remediation of groundwater beneath the Laboratory, which was contaminated with volatile organic compounds during early operations. These units are just as effective yet cost only 40 percent of fixed treatment facilities and attendant pipelines.

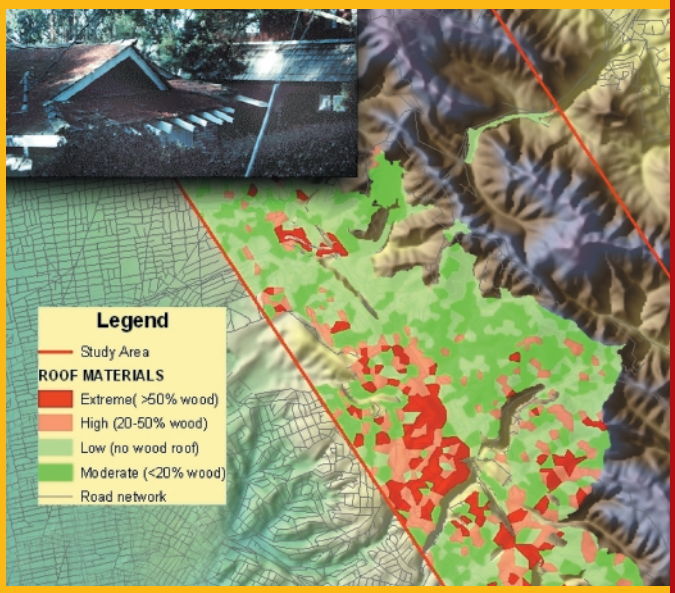
Laboratory operations posed no threat to the environment for the year. We continually monitor the air and wastewater from the Laboratory and test soil samples for radioactive and hazardous materials. Through efforts in waste minimization and pollution prevention, we have increased the amount of recycling and diversion of wastes from disposal. Remediation activities continue to remove volatile organic compounds from offsite groundwater such that contaminated plumes have been pulled back to just beyond the Laboratory's western boundary.

Meeting California's Needs

From analyzing the consequences of seismic activity to developing technologies to monitor movement and remediation of contaminated groundwater, Livermore pursues technological innovations that apply to important issues in California. For example, we are working with Los Alamos on a Wildfire Behavior Prediction Initiative. The effort combines Los Alamos' ongoing wildfire modeling effort with weather models at Livermore's National Atmospheric Release Advisory Center (NARAC). The goal is to develop a computer simulation capability that will support firefighters in real time by predicting the behavior of wildfires and weather. We are applying our current models to simulate the smoke behavior from prescribed burns in Los Angeles County (for the L.A. County Fire Department) and are preparing to support prescribed burns at Fort Ord, California (for the Army). In addition, we are working with the East Bay Regional Park District to study wildfire scenarios in the hills of Oakland, California, using a high-resolution database.

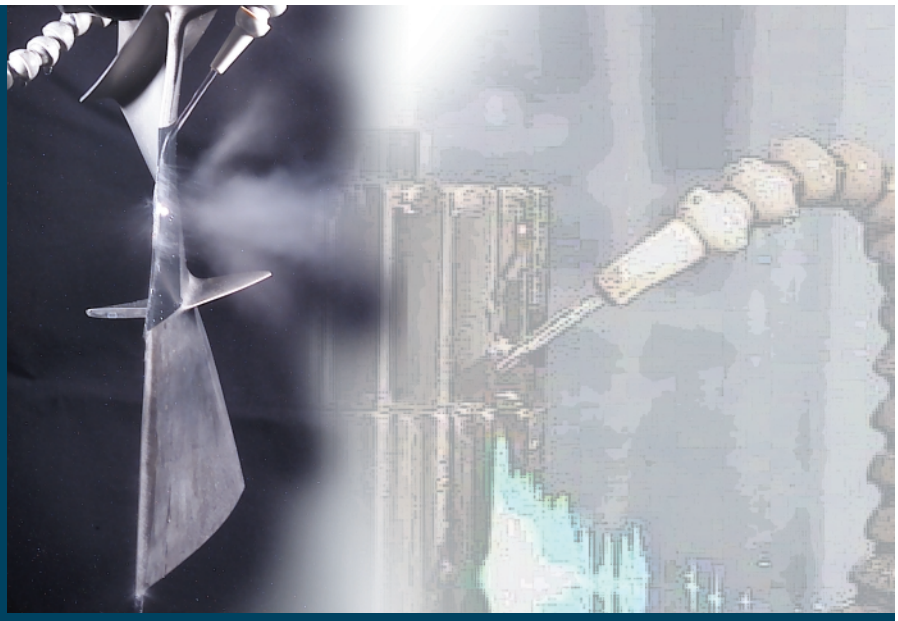
Laboratory Employees Donate $1.26 Million

The annual campaign to Help Others More Effectively (HOME) raised $1.26 million for Bay Area and Central Valley charity organizations in 2000, breaking the previous year's record. HOME is but one example of many outreach activities that include employee participation in community economic development organizations; environmental, health, and safety working groups; and educational activities such as science fairs and student and teacher programs.



The database for studies of wildfire scenarios in the hills of Oakland, California, includes detailed information about roads, terrain, and vegetative fuels as well as the roof and siding materials used in each of 51,452 houses in the area.

Through major partnerships with U.S. industry, the Laboratory is acquiring mission-critical capabilities such as the Accelerated Strategic Computing Initiative and constructing the National Ignition Facility. We obtain other critical capabilities needed at the Laboratory through partnerships, and we create new opportunities for U.S. industry by "spinning off" technologies.



New Capabilities through Partnerships

A melting operator performs a visual inspection of the continuous melting laser glass as it comes out of the Lehr oven at Hoya Corporation. Each laser glass slab is carefully fine annealed and extensively tested and inspected. The glass produced by a continuous melting system has successfully achieved the stringent specifications required for NIF.

Technology Development with Industry

Livermore's interactions with U.S. industry are exemplified by our 88 active licensing agreements, 47 cooperative research and development agreements, 175 reported inventions, 299 industrial work-for-others agreements, 112 patent applications, and 95 issued patents in FY 2000.

For example, we are partnering with BioLuminate Inc. to develop Smart Probe, a tool for detecting early breast cancer with accuracy levels comparable to biopsies but without removing tissue.

In a licensing agreement, MiniMed Inc. is using a novel Livermore technology to develop a noninvasive glucose measurement for continuously indicating the sugar level in diabetic patients. When used with an implanted insulin pump, the two devices would essentially become an artificial pancreas.

In another licensing agreement with two companies, FlexICs Inc. and Rolltronics, a Livermore laser-based technique is being developed for producing plastic flat-panel displays. Plastic displays are rugged, compact, and lightweight, and they are cheaper to produce than the glass displays that they would replace.

We are one of the founding partners (with Sandia National Laboratories, the City of Livermore, and private-sector sponsors) of the Tri-Valley Technology Enterprise Center (TTEC)—a regional business incubator under the aegis of the Tri-Valley Business Council. TTEC is providing support for start-up high-tech companies.

Laser Glass Production for NIF

The construction of the National Ignition Facility (NIF) at Livermore relies on hundreds of partnerships to develop the required technologies. For example, obtaining large quantities of quality glass was one of the project's top technological and manufacturing challenges. By the end of January 2001, our commercial vendors, Schott Glass Technologies and Hoya Corporation, had produced more than 1,000 laser glass slabs for NIF, roughly half of the total laser glass slabs needed.

Research and development spearheaded by Livermore and the two glass manufacturers made production possible. Both Schott and Hoya demonstrated a process to ensure economical production of high-optical-quality, neodymium-doped, phosphate laser glass at a rate

The LaserShot℠ Peening system won a 2000 Federal Laboratory Consortium Award of Excellence in Technology Transfer for transferring technology to the commercial marketplace. Because laser peening is more effective than other strengthening methods, parts such as aircraft engine fan blades and gears can be made thinner and thus lighter. In addition, laser-peened products will probably need less energy to operate.

20 times faster than could be achieved using existing technology. They carried out cooperative research specifically aimed at reducing moisture contamination so that the glass would meet the stringent specifications required for NIF.

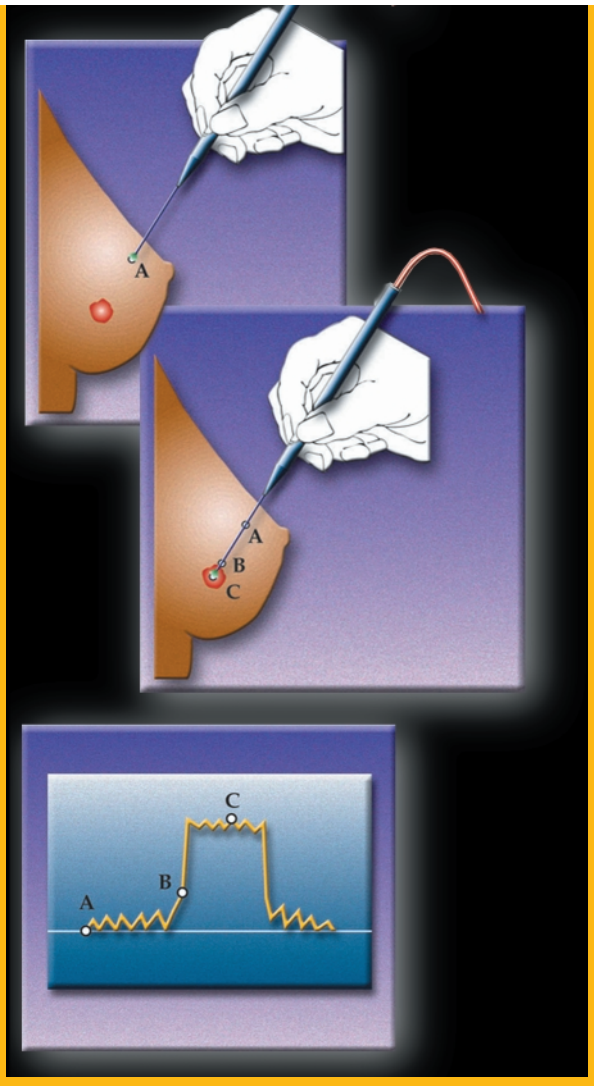
Preparing to Demonstrate EUV Lithography

Teamed together as a Virtual National Laboratory (VNL), researchers from Lawrence Livermore, Sandia, and Lawrence Berkeley national laboratories are working with an industrial consortium to develop next-generation technology for semiconductor manufacturing. The team is pursuing extreme-ultraviolet (EUV) lithography as a means for etching ultrathin patterns into silicon chips. The research and development effort by VNL is a $250-million, multiyear cooperative research and development agreement (CRADA) with the EUV LLC (Limited Liability Corporation) consortium consisting of Intel, AMD, Motorola, Micron, and Infineon.

Efforts by VNL have focused on integrating the necessary technologies into an engineering test stand that will function as a prototype EUV lithography system. Livermore leads the efforts in the test stand's optical systems and components, thin films, masks, and submicrometer metrology. A goal for early 2001 is to use the test stand to print patterns onto silicon chips with features as small as 0.10 micrometer, or about a thousandth the width of a human hair. Through further technological improvements, engineers expect to shrink features to less than 0.03 micrometer, making it possible to manufacture the much smaller, more powerful chips.

PEREGRINE Goes Commercial

Livermore's PEREGRINE technology is a revolutionary tool for analyzing and planning radiation treatment for cancer patients. The NOMOS Corporation has been licensed by Livermore to use the PEREGRINE technology and recently was granted clearance by the U.S. Food and Drug Administration to produce and market PEREGRINE systems to the medical community. Compared with other dose-calculation methods in current use, PEREGRINE more exactly estimates the radiation being delivered to a specific tumor and nearby tissue. Its modeling explicitly accounts for inhomogeneities in the body such as air, muscle, and bone that are identified on the patient's computed tomography (CT) scan.



We are partnering with BioLuminate Inc. to develop Smart Probe, a tool for detecting early breast cancer without biopsy. Sensors on the tip of the probe measure in real time the optical, electrical, and chemical properties that are known to differ between healthy and cancerous tissues. Physicians can then determine whether more tests are necessary.

Livermore researchers are developing technologies to carefully control the wavefront of 13.4-nanometer-wavelength light reflected by very precise mirrors. The shape of the wavefront must be accurate to 1 nanometer for EUV lithography to be able to produce next-generation silicon chips with features as small as 30 nanometers.

Each year, the scientific and technological accomplishments of our employees are recognized outside the Laboratory by prizes, awards, and front-page publicity. Some of these achievements are described here. In addition, a program of directorate-level awards was instituted to formally recognize within the Laboratory outstanding achievements by individuals and project teams. In all, more than 3,600 awards were presented in 2000.

Award-Winning Science and Technology

Edward Teller Fellows

The first group of Edward Teller fellows was named in 2000. They are Christine Hartmann-Siantar (for leadership in the PEREGRINE program), Bill Nellis (for discovery of metallized fluid hydrogen), Anne Happel (for the study of environmental contaminants in groundwater), and Mordy Rosen (for long-standing scientific excellence). The recipients are provided a year-long opportunity to do self-directed work for the benefit of the Laboratory.

Lawrence Livermore Fellowships are awarded to attract outstanding postdoctoral fellows and continue the Laboratory's tradition of breakthrough science and technology.

Many Significant Honors and Awards

Former Livermore director Herbert York received the Enrico Fermi Medal, given for a lifetime achievement in the field of nuclear energy.

The Laboratory shared the most prestigious award in high-performance computing—a Gordon Bell Prize—for a second consecutive year. Representing Livermore was Bruce Curtis of the team winning the special category for high-performance reactive fluid flow simulations using adaptive refinement on thousands of processors. Other team members were from the University of Chicago, Intel Corp., Drexel University, and NASA.

The American Physical Society named four Laboratory physicists as new fellows: Robert Cauble, James Hammer, Joseph Nilsen, and Ann Orel Woodin.

Livermore physicist John Lindl and retiree Garth Cummings were named fellows of the American Association for the Advancement of Science.

Stephen Payne and former Laboratory researcher Mike Perry were elected fellows of the Optical Society of America.

Roger Aines was named one of Top 25 Newsmakers in the construction industry by *Engineering News-Record* for work developing steam–oxygen injection technology for cleaning petroleum contaminants.

The DoD Defense Modeling and Simulation Office honored a Laboratory

The first Edward Teller fellowships were awarded in recognition of scientific excellence (recipients have the plaques): Christine Hartmann-Siantar, Bill Nellis, Anne Happel, and Mordy Rosen. The awards were presented by Edward Teller (front) and Deputy Director Jeff Wadsworth, Director Bruce Tarter, and Deputy Director Bob Kuckuck.

team that developed the Joint Conflict and Tactical Simulation (JCATS) computer code. Faith Shimamoto led the team, which included Mike Uzelac, Hal Brand, Greg Bowers, and Tom Kelleher.

David M. Cooper, associate director for computation and Livermore's chief information officer, was named by *Computerworld* as one of the "Premier 100 Information Technology Leaders for 2000."

The Industrial Partnerships and Commercialization Office's Christine Smith was named one of the top 100 young innovators for efforts "that paved the way for productive research collaborations among thousands of people."

The Federal Laboratory Consortium honored Livermore for success in transferring two new technologies to the commercial marketplace: PEREGRINE, which will improve cancer treatment, and LaserShot℠ Peening, which will extend the life of critical metal parts such as aircraft engine fan blades.

The American Astronomical Society awarded Charles Alcock, former head of Livermore's Institute for Geophysics and Planetary Physics, the Beatrice Tinsley Prize for "innovative and original work."

Don Correll, director of Science and Technology Education, was awarded Fusion Power Associates' Special Award for Education.

Mark Herrmann, a postdoctoral fellow, received the American Physical Society's Award for Outstanding Doctoral Dissertation in Plasma Physics.

Ted Saito was named chair of the American Association of Engineering Societies.

Senior staff member Jay Davis, former associate director at Livermore, was awarded the Department of Defense Medal for Distinguished Public Service for his work as director of the Defense Threat Reduction Agency.

A DOE Project Management Award was given to the Stanford Linear Accelerator Center's B Factory project, to which the Laboratory was a major contributor.

The Laboratory garnered an R&D 100 Award with its Waste Inspection Tomography for Non-Destructive Assay, which was developed by a team of engineers and physicists headed by Patrick Roberson and Harry Martz.

John Lindl was awarded a Fusion Power Associates Year 2000 Award for leadership and excellence in fusion engineering.

Doug Faux received a letter of commendation from the U.S. Army Space and Missile Defense Command, which cited many years of distinguished service for performing and managing analyses of theater missile defense and national missile defense interceptor lethality.

STARS

To recognize star performers and their achievements, the Laboratory created a Web site—Science and Technology Awards and Recognition System (STARS)—to track and publicize the many achievements of our scientists and engineers. For information about the Laboratory's STARS project and other awards, see its Web site at http://stars.llnl.gov/.

The Waste Inspection Tomography for Non-Destructive Assay won an R&D 100 Award in 2000 for providing accurate assay values of radioactive wastes inside sealed drums.

Lawrence Livermore National Laboratory's principal asset is its workforce. Through a long association with the University of California, the Laboratory has been able to recruit a world-class workforce and sustain a tradition of scientific and technical excellence. With approximately 8,000 employees, Livermore has an essential and compelling core mission in national security and the capabilities to solve difficult, important problems.

General John Gordon, administrator of NNSA, visited Livermore in August to meet with employees and learn more about the Laboratory's programs. In an address to the staff, he reiterated his message to the American people—that NNSA and its laboratories are partners in a vital mission in national security and that the nation should take great pride in the Laboratory and its employees.

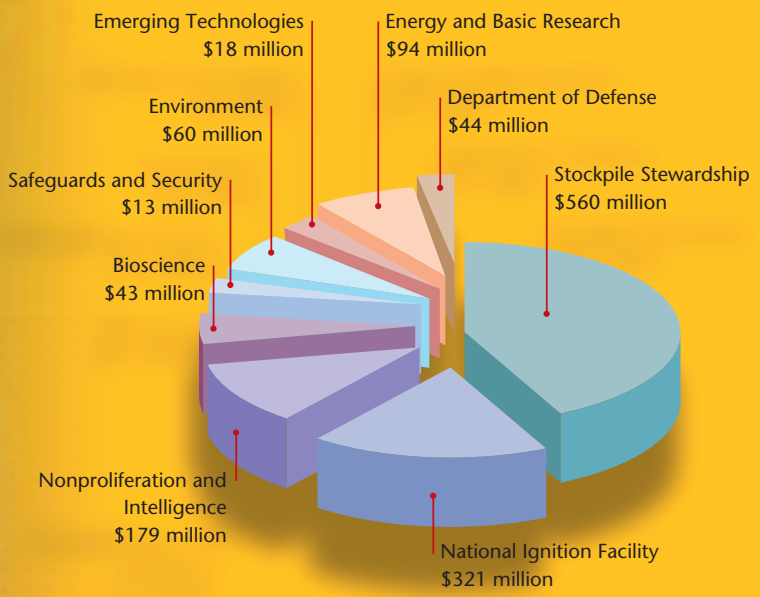
About the Laboratory's People and Programs

We Value Our Workforce

The Laboratory's achievements are the product of dedicated, high-quality efforts of all employees. We greatly value the outstanding scientific and technical achievements of the staff. Breakthrough accomplishments are critical to success and provide the foundation for future programs to meet national needs. The Laboratory's success also depends on those who provide essential services and help to make Livermore a safe, secure, healthy, and efficient place to work.

Laboratory Budget

Most of Livermore's $1.33-billion budget for FY 2000 was designated for research and development



FY 2000 Budget: $1.332 Billion

activities in program areas supporting the Department of Energy's missions.

As a national security laboratory, Livermore is part of DOE's National Nuclear Security Administration (NNSA). We receive most of our funding from the NNSA Office of Defense Programs for stockpile stewardship. We also receive funding from the NNSA Office of Defense Nuclear Nonproliferation, various Department of Defense sponsors, and other federal agencies for national security work.

As a multiprogram laboratory, we apply Livermore's special capabilities to meet important national needs. Activities are pursued for other DOE programs, principally Environmental Management, and the Offices of Science, Civilian Radioactive Waste Management, Nuclear Energy, and Security and Emergency Operations. Non-DOE sponsors include federal agencies (such as the National Aeronautics and Space Administration, Nuclear Regulatory Commission, National Institutes of Health, and Environmental Protection Agency), State of California agencies, and industry.

Find Out More about Us

Visit the Laboratory's frequently updated Web site at http://www.llnl.gov/ to learn more about our many scientific and technical programs. Discover the many opportunities for employment, academic research, and industrial partnerships. Read about our accomplishments each month in *Science & Technology Review* on the Web or in print. *S&TR*, annual reports, and other publications are consistent award winners in the Society of Technical Communication competitions.